NRCS Natural Resources Conservation Service

CSP Job Sheet

Energy Enhancement

For 2004 the Conservation Security Program offers a limited number of enhancement payments as incentives to reward or encourage on-farm energy conservation and management. These enhancements are only available once the applicant qualifies for CSP by meeting the program's entry requirements for soil and water quality.

This information is provided to assist landowners and managers in determining if they are eligible for any or all of the offered payments for energy enhancements.

Enhancement Activities: Reduced Inputs and Precision Application of Fertilizers; Reduced Tillage Operations

Apply Fertilizer at or Below Agronomic Rate

Nutrients such as nitrogen, used in crop production, are often applied in large quantities to supplement soil supplies. Nitrogen is typically supplied to crops as ammonium nitrate, diammonium phosphate (DAP), ammonium sulfate, cal-nitro (ammonium nitrate + limestone) or other inorganic form.

The amount of energy needed to produce the nitrogen portion of the fertilizers is massive, taking almost 18,000 kilocalories of energy per one kilogram of nitrogen, requiring a lot of fossil fuels. This compares to 3,000 and 2,300 kilocalories per kilogram to produce phosphate and potassium fertilizer components, respectively (Living Landscapes, Thompson/Okonagan, Ministry of Employment and Investment, Province of British Columbia, CA, 2002). There is a clear opportunity to save energy by reducing unneeded N applications. These can be made by allocating more N to the crop situations with the greatest potential response and less N to the situations where it is not needed. The producer must closely evaluate the requirements for each crop rotation, soils and climate.

Nitrogen recommendations are for the total amount of N needed. Add up the N coming from all sources and subtract these amounts from state specific fertilization recommendations. Additional efficiencies can be gained by calibrating applicators, applying fertilizer products and manure accurately, and using the correct method and placement to avoid losses and spillage.

Documentation Required: Farmer or crop consultant certification of appropriate fertilizer applications.

Ninety Percent (90%) Use of Manure and/or Legumes to Supply Crop Nutrient Needs

Livestock manure and legumes (or other green manures) are excellent fertilizer for the soil, providing such nutrients as nitrogen, phosphorus, calcium, magnesium, micronutrients, potassium and organic matter. Using alternative fertilizers to inorganic compounds will benefit the soil's water holding capacity and tilth. Additionally, this approach can reduce the consumption of fossil fuels and minerals used in the production of inorganic fertilizer, conserving energy in the process. However, when using these alternative sources, it is still essential to follow good management practices in order to avoid damage hazards to the crop and hazards to the environment.

Manure--Animal waste is an excellent source for nutrients; however, manure nutrient content varies among operations and over time. Manure applications should be based strictly on the nutrient requirement of the crop to avoid over-application and reduce the potential of nitrate-nitrogen leaching into groundwater and phosphorus being transported into streams. The following steps will assure the correct amount (agronomic rate) of manure is applied.

1. Determine crop nutrient requirements, based on a realistic yield goal;
2. Determine the nutrient content of the manure;
3. Determine the fraction of manure nutrients available to the crop in th first year of application;
4. Calculate the application rate to supply crop nutrient needs;
5. Deduct nutrients supplied from other sources;
6. Determine supplemental nutrients needed for optimum crop growth. (Using Stockpiled Feedlot Manure as Fertilizer, Oklahoma Cooperative Extension Service, Division of Agricultural Sciences and Natural Resources, 200

Legumes and Green Leaf Manures--Legumes and green leaf manures can perform a multitude of functions on the farm. Nutrients absorbed by green manure crops or those retained within crop residues after harvest, are gradually released or "mineralized" when the crop is incorporated into the soil and subsequently decomposes. Many factors govern when the nutrients will be released including the carbon/nitrogen ratio, moisture content, particle size of the soil, method of incorporation, soil nitrogen levels and temperature. Legumes and green manures, like animal-based manure, can reduce the consumption of fossil fuels as inputs needed to produce inorganic fertilizers.

Legumes are the most important of the green manures. There are several categories of legumes and green manures that are used in conservation farming.

Cover crops -- Cover crops form a mulch that protects the soil from wind and water erosion and greatly reduce annual weeds in the next growing season. Examples of annual legumes include red and sweet clover, hairy vetch, winter cereals and buckwheat.

Catch crops/nutrient conserving crops -- A catch crop only grows briefly and is either worked in after the main crop has been harvested or planted between two main crops. The catch crop protects the soil from erosion and minimizes nutrient loss from the soil through leaching. It can also enrich the soil by adding organic matter, nitrogen or other nutrients. Examples of annual legumes used as catch crops are oilradish, red clover and buckwheat.

Smother crops – A smother crop is a green manure crop is grown primarily to control weeds. It is characterized by extremely dense, vigorous and rapid growth. Smother crop species are usually selected with specific weeds in mind. For example, in some regions, fall rye is used against quack grass because its vigorous growth in spring coincides with the growth cycle of quack grass.

Documentation Required: Farmer or crop consultant certification of appropriate fertilizer applications.

STIR Ratings (Less Than 60, 20 & 10)

Soil Tillage Intensity Rating (STIR) is a calculation based on the location of cropland and the Crop Management System that the producer employs on that land. It is an index used to evaluate the kind, severity and number of ground disturbing tillage passes on soil quality. Higher numbers indicate greater disturbance; lower numbers indicate less disturbance.

The components of STIR are: operating speed of tillage equipment, tillage type, tillage depth and the percent of surface area disturbed. Weights are assigned to each component to calculate a rating. This rating is useful in making residue management decisions. It is one of three outputs from the Revised Universal Soil Loss Equation Version 2.0. (RUSLE2). The other outputs are a soil loss estimate and a soil organic matter trend estimate from the Soil Conditioning Index.

Documentation Required: STIR ratings from RUSLE2.

Energy Enhancement Activities

For 2005, the Conservation Security Program (CSP) offers a limited number of enhancement payments as incentives to reward or encourage on-farm energy conservation and management. These enhancements are available once the applicant qualifies for CSP by meeting the program's entry requirements for soil and water quality.

This information will help landowners and managers determine if they are eligible for the offered payment(s) for energy enhancement activities.

Use of Manure, Legumes and Alternatives to Supply Crop Nutrient Needs

Nutrients, such as nitrogen used in crop production, often are applied in large quantities to supplement soil supplies. Nitrogen typically is supplied to crops as ammonium nitrate, diammonium phosphate (DAP), ammonium sulfate, cal-nitro (ammonium nitrate + limestone) or other inorganic form.

The amount of energy needed to produce the nitrogen portion of the fertilizers is massive, almost 18,000 kilocalories of energy per one kilogram of nitrogen, and requires large quantities of fossil fuels. This compares to 3,000 and 2,300 kilocalories per kilogram to produce phosphate and potassium fertilizer components, respectively[1]. There is a clear opportunity to save energy by reducing unneeded nitrogen applications. These can be made by crediting nitrogen produced on-site by cover crops and legume crops, and by using other readily available organic sources of nutrients (such as manures) as fertilizer for crops in rotation. The producer must closely evaluate the requirements for each crop rotation, soil, and climate.

Nitrogen recommendations are for the total amount of nitrogen needed. Add up the nitrogen coming from all sources and subtract these amounts from state specific fertilization recommendations. Additional efficiencies can be gained by calibrating applicators, applying fertilizer products and manure accurately, and using the correct method and placement to avoid losses and spillage.

Use of Manure and/or Legumes to Supply 90% of Crop Nutrient Needs
Livestock manure and legumes (or other green manures) are excellent fertilizer for the soil, providing such nutrients as nitrogen, phosphorus, calcium, magnesium, micronutrients, potassium, and organic matter. Using alternative fertilizers to inorganic compounds will benefit the soil's water-holding capacity and tilth. Additionally, this approach can reduce the consumption of fossil fuels and minerals used in the production of inorganic fertilizer, conserving energy in the process. However, when using these alternative sources, it is still essential to

follow good management practices in order to avoid damage to the crop and hazards to the environment. Because the ratios of nitrogen to phosphorus and potassium in manure is lower than this ratio in the crop, use of manure alone to supply 90 percent of the crop nutrients needs will result in an over application of phosphorus and potassium. Therefore, good agronomic practice would indicate use of more than one organic source to achieve this energy enhancement. Some of the alternative nutrient sources are listed below:

Manure **–** Animal waste is an excellent source for nutrients; however, manure nutrient content varies among operations and over time. Manure applications should be based strictly on the nutrient requirement of the crop to avoid over-application and reduce the potential of nitrate-nitrogen leaching into groundwater and phosphorus being transported into streams. The following steps[2] will assure the correct amount (agronomic rate) of manure is applied.

1. Determine crop nutrient requirements, based on a realistic yield goal.
2. Determine the nutrient content of the manure.
3. Determine the fraction of manure nutrients available to the crop in the first year of application.
4. Calculate the application rate to supply crop nutrient needs.
5. Deduct nutrients supplied from other sources.
    a. Determine the nutrient content of the other sources.
    b. Determine the fraction of nutrients in alternative sources available to the crop in the first year of application.
6. Determine supplemental nutrients needed for optimum crop growth.

Legumes and Green Leaf Manures **–** Legumes and green leaf manures can perform a multitude of functions on the farm. Nutrients absorbed by green manure crops or those retained within crop residues after harvest, are gradually released or "mineralized" when the crop is incorporated into the soil and subsequently decompose. Many factors govern when the nutrients will be released, including the carbon/nitrogen ratio, moisture content, particle size of the soil, method of incorporation, soil nitrogen levels, and temperature. Legumes and green manures, like animal-based manure, can reduce the consumption of fossil fuels as inputs needed to produce inorganic fertilizers.

Legumes are the most important of the green manures. There are several categories of legumes and green manures that are used in conservation farming.

Cover crops **–** Cover crops form a mulch that protects the soil from wind and water erosion and greatly reduce annual weeds in the next growing season. Examples of annual legumes include red and sweet clover, hairy vetch, winter cereals, and buckwheat.

Catch crops / nutrient conserving crops **–** A catch crop only grows briefly and is either worked in after the main crop has been harvested or planted between two

main crops. The catch crop protects the soil from erosion and minimizes nutrient loss from the soil through leaching. It can also enrich the soil by adding organic matter, nitrogen, or other nutrients. Examples of annual legumes used as catch crops are oilradish, red clover, and buckwheat.

Smother crops **–** A smother crop is a green manure crop grown primarily to control weeds. It is characterized by extremely dense, vigorous, and rapid growth. Smother crop species usually are selected with specific weeds in mind. For example, in some regions, fall rye is used against quack grass because its vigorous growth in spring coincides with the growth cycle of quack grass.

Documentation Required: Farmer or crop consultant certification of appropriate fertilizer applications.

Annual or Perennial Legumes in Crop Rotation

Legumes in rotations form symbiotic associations with nitrogen-fixing bacteria. Through these associations they are able to supply not only the nitrogen for their own needs but a portion of the nitrogen used by the following crop. The actual amount of nitrogen supplied depends on the species grown as well as soil and climatic conditions. In general, however, the longer the legume is allowed to grow, the greater the amount of nitrogen produced. Perennial legumes tend to provide a far greater nitrogen savings than their annual counterparts. Not only are nitrogen inputs not required while the legume is growing, the additional nitrogen available to the following crop is significantly greater for perennial legumes than the nitrogen from annual legumes.

Documentation Required: Farmer or crop consultant certification.

[1] Living Landscapes, Thompson/Okonagan, Ministry of Employment and Investment, Province of British Columbia, CA, 2002

[2] Using Stockpiled Feedlot Manure as Fertilizer, Oklahoma Cooperative Extension Service, Division of Agricultural Sciences and Natural Resources

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CSP Energy Enhancement

Energy Assessment Worksheet

Baseline Agricultural Energy Use Assessment Worksheet[1/]

Farm or Ranch Identification:

Energy Source	Current Use (10^3 Btu)[2/]	Planned Use (10^3 Btu)	Net saving (%)
Electricity			
Natural Gas			
Propane (excluding vehicle use)			
Diesel (excluding vehicle use)			
Other			

Planned Energy Use Reduction Strategies

Items to consider	HP/Watts	Hrs used	Proposed Reduction Strategy (describe briefly where applicable)
Lights			
Fans			
Engines			
Irrigation pumps			
Vacuum pumps			
Hot water			
Heating/cooling systems			
Drying systems			
Refrigeration			
Other (specify)			

[1/] Baseline assessment excludes farmstead energy use and vehicle use

[2/] 1 KWh = 3.41 x 10^3 Btu 1Gallon propane = 91 x 10^3 Btu

1Therm natural gas = 102.6 x 10^3 Btu 1 Gallon diesel = 139 x 10^3 Btu

Client Signature Date

United States Department of Agriculture
NRCS Natural Resources Conservation Service

Example Activities to Increase Energy Efficiency On Farms or Ranches

a. Irrigation Improvements

Size pump correctly for system
Switch line sizes to match pump size
Type of Pump, i.e., centrifuge, piston, etc.
Fuel type
Gravity flow where possible

b. Grain drying

Install sensors to optimize overdrying and utilize only energy needed
Utilize unheated air
Newer gas dryers are more energy efficient than older models
Heat pumps
Note: Over heating can decrease grain quality. Solar and Wind energy powered dryers are on the leading edge in the science of grain drying.

c. Animal housing and Processing

Coupling heating/cooling and refrigeration systems
Use of variable speed vacuum pumps – Noise factor in dairies
Energy efficient lighting
High Volume/Low speed fans
Insulation
Insulated watering devices
Energy efficient heating systems

d. Other farm buildings excluding the homestead

Install florescent lighting
Upgrade heating and cooling systems

e. Greenhouses

Energy efficient lighting
High volume/low speed fans
Switch to solar – solar heat sinks

f. Animal Waste Distribution

Optimizing - sizing motors to piping system to system needs